AMENDMENTS TO THE CLAIMS

Please replace all previous listing of the claims with the following:

1. (Cancelled)

2. (Previously Presented) The electrochemical gas sensor as defined in claim 82, further comprising:

means for applying DC power across the protonic conductive electrolyte membrane;

an electrical connection between the sensing electrode, the counter electrode, and the means for applying DC power across the protonic conductive electrolyte membrane; and

switch means for alternating an electrical connection between the sensing electrode and counter electrode from the electrical measurement means to the means for applying DC power across the protonic conductive electrolyte membrane;

whereby the gas is transported away from the counter electrode when the means for applying DC power across the protonic conductive electrolyte membrane applies a DC power to the sensing and counter electrodes.

3. (Cancelled)

4. (Cancelled)

5. (Cancelled)

6. (Cancelled)

7. (Cancelled)

8. (Cancelled)

9. (Cancelled)

10. (Cancelled)

11. (Cancelled)

12. (Cancelled)

13. (Cancelled)

14. (Cancelled)

15. (Cancelled)

16. (Cancelled)

17. (Currently Amended) The electrochemical gas sensor as defined in claim [109] 82, wherein one of the first and second electrical conductor materials for the counter electrode is 50-99 wt% of carbon black, and the other of the first and second electrical conductor materials for the counter electrode is 1-50 wt% of Ru oxide.

18. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the electrochemical gas sensor further comprises:

first and second porous mixed ionic-electronic conductive pump electrodes each having both an electronic conductive material and an ionic conductive material, each of said first and second pump electrodes being separate from said sensing and counter

electrodes and situated on opposite sides of and in contact with said protonic conductive electrolyte membrane;

means for applying a DC power across the membrane;

said first and second pump electrodes having in electrical connection therebetween said means for applying DC power across the membrane;

whereby the gas is transported away from the counter electrode when said means for applying DC power across the membrane applies a DC power to the first and second pump electrodes.

19. (Original) The electrochemical gas sensor of claim 18, wherein the electronic and ionic conducting materials of the first and second pumping electrodes comprise carbon.

20. (Original) The electrochemical gas sensor as defined in claim 18, wherein the electronic and ionic conducting materials of the first and second pumping electrodes comprise noble metals.

21. (Original) The electrochemical gas sensor as defined in claim 18, wherein the electronic and ionic conducting materials of the first and second pumping electrodes comprise conductive metal oxides.

22. (Original) The electrochemical gas sensor as defined in claim 18, wherein the first and second pumping electrodes have a diameter of about 10 mm, and the first protonic conductive electrolyte membrane has a thickness of about 0.17 mm.

23. (Original) The electrochemical gas sensor as defined in claim 18, wherein the electronic and ionic conducting materials of said first and second pumping electrodes are a proton-electron mixed conductive material having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials.

24. (Original) The electrochemical gas sensor as defined in claim 23, wherein the proton conductor material for both the first and second pumping electrodes is a copolymer having a tetrafluorethylene backbone with a side chain of perfluorinated monomers containing at least one of a sulfonic acid group or a carboxylic acid group.

25. (Original) The electrochemical gas sensor as defined in claim 23, wherein one of the first and second electrical conductor materials for the first pumping electrode is 50-99 wt% of carbon black, and the other of the first and second electrical conductor materials for the first pumping electrode is 10 to 50 wt% of platinum.

26. (Original) The electrochemical gas sensor as defined in claim 23, wherein one of the first and second electrical conductor materials for the second pumping electrode is 50-99 wt% of carbon black, and the other of the first and second electrical conductor materials for the second pumping electrode is 10 to 50 wt% of Ru oxide.

27. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the electrochemical gas sensor further comprises:

a second protonic conductive electrolyte membrane;

first and second porous mixed ionic-electronic conductive pump electrodes each having both an electronic conductive material and an ionic conducting material, each of said first and second pump electrodes being separate from said sensing and counter electrodes and situated on opposite sides of and in contact with said second protonic conductive electrolyte membrane;

means for applying a DC power across said second protonic electrolyte membrane; said first and second pump electrodes having in electrical connection therebetween said means for applying DC power across said second protonic electrolyte membrane;

whereby the gas is transported away from the counter electrode when said means for applying DC power across said second protonic electrolyte membrane applies a DC power to the first and second pump electrodes.

28. (Original) The electrochemical gas sensor as defined in claim 27, wherein the second protonic conductive electrolyte membrane is substantially comprised of a solid, perfluorinated, ion-exchange polymer.

29. (Original) The electrochemical gas sensor as defined in claim 27, wherein the second protonic conductive electrolyte membrane is a metal oxide protonic conductor electrolyte membrane.

30. (Previously Presented) An electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material;

a protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes;

the sensing electrode reacting with the gas to produce a change in an electrical characteristic between the sensing electrode and the counter electrode;

means for electrical measurement;

said sensing and counter electrodes having electrically connected therebetween said means for electrical measurement;

means for applying a DC pulse power source across the membrane;

said sensing and counter electrodes having in electrical connection therebetween said means for applying DC pulse power across the membrane; and

switch means for alternating the connection between the sensing and counter electrodes from the electrical measurement means to the means for applying a DC pulse power source across the membrane;

whereby, in a positive ambient concentration of said gas, said electrical measurement means detects changes in said electrical characteristic when said switch

means connects said electrical measurement means to the sensing and counter electrodes; and whereby said means for applying a DC pulse power source across the membrane moves CO away from a side of the gas sensor where the counter electrode is placed when said switch means connects said means for applying a DC pulse power source across the membrane to the sensing and counter electrodes.

31. (Original) The electrochemical gas sensor as defined in claim 30, wherein said sensing and counter electrodes comprise carbon.

32. (Original) The electrochemical gas sensor as defined in claim 30, wherein said sensing and counter electrodes comprise noble metals.

33. (Original) The electrochemical gas sensor as defined in claim 30, wherein said sensing and counter electrodes comprise conductive metal oxides.

34. (Original) The electrochemical gas sensor as defined in claim 30, wherein the protonic conductive electrolyte membrane is substantially comprised of a solid, perfluorinated, ion-exchange polymer.

35. (Original) The electrochemical gas sensor as defined in claim 30, wherein the protonic conductive electrolyte membrane is a metal oxide protonic conductor electrolyte membrane.

36. (Original) The electrochemical gas sensor as defined in claim 30, wherein the electrochemical gas sensor is adapted to detect CO.

37. (Original) The electrochemical gas sensor as defined in claim 30, wherein the electrochemical gas sensor is adapted to detect hydrogen.

38. (Original) The electrochemical gas sensor as defined in claim 30, wherein the electrochemical gas sensor is adapted to detect H_2S.

39. (Original) The electrochemical gas sensor as defined in claim 30, wherein the electrochemical gas sensor is adapted to detect H_2O vapor.

40. (Original) The electrochemical gas sensor as defined in claim 30, wherein the electrochemical gas sensor is adapted to detect NO_x.

41. (Original) The electrochemical gas sensor as defined in claim 30, wherein the sensing and counter electrodes have a diameter in a range of 1 mm to 15 mm, and the protonic conductive electrolyte membrane has a thickness in a range of 0.1 mm-1 mm.

42. (Original) The electrochemical gas sensor as defined in claim 41, wherein the sensing and counter electrodes have a diameter of about 10 mm, and the protonic conductive electrolyte membrane has a thickness of about 0.17 mm.

43. (Original) The electrochemical gas sensor as defined in claim 30, wherein the electronic and ionic conducting materials of said sensing and counter electrodes are a proton-electron mixed conductive material having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials.

44. (Original) The electrochemical gas sensor as defined in claim 43, wherein the proton conductor material for both the sensing and counter electrodes is a copolymer having a tetrafluorethylene backbone with a side chain of perfluorinated monomers containing at least one of a sulfonic acid group or a carboxylic acid group.

45. (Original) The electrochemical gas sensor as defined in claim 43, wherein one of the first and second electrical conductor materials for the sensing electrode is 50-99 wt% of

carbon black, and the other of the first and second electrical conductor materials for the sensing electrode is 1-50 wt% of platinum.

46. (Original) The electrochemical gas sensor as defined in claim 43, wherein one of the first and second electrical conductor materials for the counter electrode is 50-99 wt% of carbon black, and the other of the first and second electrical conductor materials for the counter electrode is 1-50 wt% of Ru oxide.

47. (Previously Presented) An electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material and being exposed to the ambient atmosphere;

a porous mixed ionic-conductive counter electrode having both an electronic conducting material and an ionic conducting material;

a first protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes;

the sensing electrode reacting with the gas to produce a change in an electrical characteristic between the sensing electrode and the counter electrode;

a second protonic conductive electrolyte membrane;

first and second porous mixed ionic-electronic conductive pump electrodes, each having both an electronic conductive material and an ionic conducting material, each of said first and second pump electrodes being separate from said sensing and counter electrodes and situated on opposite sides of and in contact with said second protonic conductive electrolyte membrane;

said first porous pump electrode being exposed to a chamber sealed off from the ambient atmosphere;

said second porous pump electrode being separated from said counter electrode by a perforated support structure composed of an electrical conducting material, both said

second porous pump electrode and said counter electrode being in contact with said perforated support structure;

means for electrical measurement in electrical contact with said sensing electrode and perforated support structure;

means for applying a DC power across said second protonic electrolyte membrane in electrical contact with said first pump electrode and said perforated support structure; whereby the gas is transported away from the counter electrode when the means for applying a DC power across said second protonic electrolyte membrane applies a DC power across said second protonic electrolyte membrane; and

whereby, in a positive ambient concentration of said gas, said electrical measurement means detects changes in said electrical characteristic.

48. (Original) The electrochemical gas sensor as defined in claim 47, wherein the sensing and counter electrodes have a diameter in a range of 1 mm-15 mm, and the protonic conductive electrolyte membrane has a thickness in a range of 0.1 mm-1 mm.

49. (Original) The electrochemical gas sensor as defined in claim 48, wherein the sensing and electrodes have a diameter of about 10 mm, and the protonic conductive electrolyte membrane has a thickness of about 0.17 mm.

50. (Original) The electrochemical gas sensor as defined in claim 47, wherein the electronic and ionic conducting materials of said sensing and counter electrodes are a proton-electron mixed conductive material having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials.

51. (Original) The electrochemical gas sensor as defined in claim 50, wherein the proton conductor material for both the sensing and counter electrodes is a copolymer having a tetrafluorethylene backbone with a side chain of perfluorinated monomers containing at least one of a sulfonic acid group or a carboxylic acid group.

52. (Original) The electrochemical gas sensor as defined in claim 50, wherein one of the first and second electrical conductor materials for the sensing electrode is 50-99 wt% of carbon black, and the other of the first and second electrical conductor materials for the sensing electrode is 1-50 wt% of platinum.

53. (Original) The electrochemical gas sensor as defined in claim 50, wherein one of the first and second electrical conductor materials for the counter electrode is 50-99 wt% of carbon black, and the other of the first and second electrical conductor materials for the counter-reference electrode is 1-50 wt% of Ru oxide.

54. (Original) The electrochemical gas sensor as defined in claim 47, wherein the electrochemical gas sensor is adapted to detect CO.

55. (Original) The electrochemical gas sensor as defined in claim 47, wherein the electrochemical gas sensor is adapted to detect hydrogen.

56. (Original) The electrochemical gas sensor as defined in claim 47, wherein the electrochemical gas sensor is adapted to detect NO_x.

57. (Original) The electrochemical gas sensor as defined in claim 47, wherein the electrochemical gas sensor is adapted to detect H_2O vapor.

58. (Original) The electrochemical gas sensor as defined in claim 47, wherein the electrochemical gas sensor is adapted to detect H_2S.

59. (Previously Presented) An electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material and being exposed to the ambient atmosphere;

a porous mixed ionic-electronic conductive reference electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-conductive counter electrode having both an electrical conducting material and an ionic conducting material, and being separate from both said sensing and reference electrodes;

a protonic conductive electrolyte membrane, having top and bottom sides, said top side of said protonic conductive membrane being in contact with the counter electrode and the reference electrode, the bottom side of said protonic conductive membrane being in contact with the sensing electrode;

the sensing electrode reacting with the gas to produce a change in an electrical characteristic between the sensing electrode and the counter electrode;

means for electrical measurement in electrical contact between the sensing electrode and the counter electrode;

means for applying a DC power across said protonic electrolyte membrane in electrical contact between the sensing electrode and said reference electrode;

whereby the gas is transported away from the reference electrode when the means for applying a DC power across said protonic electrolyte membrane applies a DC power across said protonic electrolyte membrane; and

whereby, in a positive ambient concentration of said gas, said electrical measurement means detects changes in said electrical characteristic.

60. (Original) The electrochemical gas sensor as defined in claim 59, wherein said sensing, count and reference electrodes comprise carbon.

61. (Original) The electrochemical gas sensor as defined in claim 59, wherein said sensing, count and reference electrodes comprise noble metals.

62. (Original) The electrochemical gas sensor as defined in claim 59, wherein said sensing, counter and reference electrodes comprise conductive metal oxides.

63. (Original) The electrochemical gas sensor as defined in claim 59, wherein the protonic conductive electrolyte membrane is substantially comprised of a solid, perfluorinated, ion-exchange polymer.

64. (Original) The electrochemical gas sensor as defined in claim 59, wherein the protonic conductive electrolyte membrane is a metal oxide protonic conductor electrolyte membrane.

65. (Original) The electrochemical gas sensor as defined in claim 59, wherein the electrochemical gas sensor is adapted to detect CO.

66. (Original) The electrochemical gas sensor as defined in claim 59, wherein the electrochemical gas sensor is adapted to detect NO_x.

67. (Original) The electrochemical gas sensor as defined in claim 59, wherein the electrochemical gas sensor is adapted to detect hydrogen.

68. (Original) The electrochemical gas sensor as defined in claim 59, wherein the electrochemical gas sensor is adapted to detect H_2S.

69. (Original) The electrochemical gas sensor as defined in claim 59, wherein the electrochemical gas sensor is adapted to detect H_2O vapor.

70. (Original) The electrochemical gas sensor as defined in claim 59, wherein the sensing, counter and reference electrodes have a diameter of about 10 mm, and the protonic conductive electrolyte membrane has a thickness of about 0.17 mm.

71. (Original) The electrochemical gas sensor as defined in claim 59, wherein the electronic and ionic conducting materials of said sensing, counter and reference electrodes are a proton-electron mixed conductive material having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and second electrical conductor materials.

72. (Original) The electrochemical gas sensor as defined in claim 71, wherein the proton conductor material for both the sensing, counter and reference electrodes is a copolymer having a tetrafluorethylene backbone with a side chain of perfluorinated monomers containing at least one of a sulfonic acid group or a carboxylic acid group.

73. (Original) The electrochemical gas sensor as defined in claim 71, wherein one of the first and second electrical conductor materials for the sensing electrode is 50-99 wt% of carbon black, and the other of the first and second electrical conductor materials for the sensing electrode is 1-50 wt% of platinum.

74. (Original) The electrochemical gas sensor as defined in claim 71, wherein one of the first and second electrical conductor materials for the counter and reference electrodes is 50-99 wt% of carbon black, and the other of the first and second electrical conductor materials for the counter and reference electrodes is 1-50 wt% of Ru oxide.

75. (Cancelled)

76. (Original) The electrochemical gas sensor as defined in claim 30, wherein the sensing and the counter electrodes each have a first side opposite a second side, and wherein the ionic and electronic conducting materials are continuous from the first side to the opposite second side within each of the sensing and counter electrodes.

77. (Original) The electrochemical gas sensor as defined in claim 47, wherein the sensing, counter, first pumping, and second pumping electrodes each have a first side opposite a

second side, and wherein the ionic and electronic conducting materials are continuous from the first side to the opposite second side within each of the sensing, counter, first pumping, and second pumping electrodes.

78. (Original) The electrochemical gas sensor as defined in claim 59, wherein the sensing, counter, and reference electrodes each have a first side opposite a second side, and wherein the ionic and electronic conducting materials are continuous from the first side to the opposite second side within each of the sensing, counter, and reference electrodes.

79. (Previously Presented) A two-electrode electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material;

wherein the electronic and ionic conducting materials of said sensing and counter electrodes are proton-electron mixed conductive materials having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials;

a first protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes, and having a thickness in the range of approximately 0.1 mm to 1 mm, the sensing electrode and the counter electrode being the only two electrodes in contact with the first protonic conductive electrolyte membrane;

the sensing electrode reacting with the gas to produce a change in an electrical characteristic between the sensing electrode and the counter electrode;

means for electrical measurement;

said sensing and counter electrodes each having a diameter in the range of approximately 1 mm to 15 mm, and being electrically connected to said electrical measurement means;

whereby, in a positive ambient concentration of said gas, said electrical measurement means detects changes in said electrical characteristic.

80. (Previously Presented) An electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material;

wherein the electronic and ionic conducting materials of said sensing and counter electrodes are proton-electron mixed conductive materials having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials;

a first protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes, and having a thickness in the range of approximately 0.1 mm to 1 mm;

the sensing electrode reacting with the gas to produce a change in an electrical characteristic between the sensing electrode and the counter electrode in the absence of an applied voltage to the sensing electrode;

means for electrical measurement;

said sensing and counter electrodes each having a diameter in the range of approximately 1 mm to 15 mm, and being electrically connected to said electrical measurement means;

whereby, in a positive ambient concentration of said gas, said electrical measurement means detects changes in said electrical characteristic.

81. (Previously Presented) A two-electrode electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material;

wherein the electronic and ionic conducting materials of said sensing and counter electrodes are proton-electron mixed conductive materials having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials;

a first protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes, and having a thickness in the range of approximately 0.1 mm to 1 mm, the sensing electrode and the counter electrode being the only two electrodes in contact with the first protonic conductive electrolyte membrane;

the sensing electrode reacting with the gas to produce a change in an electrical characteristic between the sensing electrode and the counter electrode in the absence of an applied voltage to the sensing electrode;

means for electrical measurement;

said sensing and counter electrodes each having a diameter in the range of approximately 1 mm to 15 mm, and being electrically connected to said electrical measurement means;

whereby, in a positive ambient concentration of said gas, said electrical measurement means detects changes in said electrical characteristic.

82. (Previously Presented) An electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material;

wherein the electronic and ionic conducting materials of said sensing and counter electrodes are proton-electron mixed conductive materials having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials;

a first protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes, and having a thickness in the range of approximately 0.1 mm to 1 mm, the sensing electrode and the counter electrode being on opposite sides of the first protonic conductive electrolyte membrane;

the sensing electrode reacting with the gas to produce a change in an electrical characteristic between the sensing electrode and the counter electrode;

means for electrical measurement;

said sensing and counter electrodes each having a diameter in the range of approximately 1 mm to 15 mm, and being electrically connected to said electrical measurement means;

whereby, in a positive ambient concentration of said gas, said electrical measurement means detects changes in said electrical characteristic.

83. (Previously Presented) The electrochemical gas sensor of claim 82 in which the sensing electrode and the counter electrode are the only two electrodes in contact with the first protonic conductive electrolyte membrane.

84. (Previously Presented) The electrochemical gas sensor of claim 82 in which the sensing electrode reacts with the gas in the absence of an applied voltage to the sensing electrode.

85. (Previously Presented) The electrochemical gas sensor of claim 83 in which the sensing electrode reacts with the gas in the absence of an applied voltage to the sensing electrode.

86. (Previously Presented) A two-electrode electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere at room temperature comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material;

wherein the electronic and ionic conducting materials of said sensing and counter electrodes are proton-electron mixed conductive materials having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials;

a first protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes, and having a thickness in the range of approximately 0.1 mm to 1 mm, the sensing electrode and the counter electrode being the only two electrodes in contact with the first protonic conductive electrolyte membrane;

the sensing electrode reacting with the gas at room temperature to produce a change in an electrical characteristic between the sensing electrode and the counter electrode;

said sensing and counter electrodes each having a diameter in the range of approximately 1 mm to 15 mm, and being electrically connected to said electrical measurement means; and

means for electrical measurement;

whereby, in a positive ambient concentration of said gas at room temperature, said electrical measurement means detects changes in said electrical characteristic.

87. (Previously Presented) An electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere at room temperature, comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material;

wherein the electronic and ionic conducting materials of said sensing and counter electrodes are proton-electron mixed conductive materials having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials;

a first protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes, and having a thickness in the range of approximately 0.1 mm to 1 mm;

the sensing electrode reacting with the gas at room temperature to produce a change in an electrical characteristic between the sensing electrode and the counter electrode in the absence of an applied voltage to the sensing electrode;

said sensing and counter electrodes each having a diameter in the range of approximately 1 mm to 15 mm, and being electrically connected to said electrical measurement means; and

means for electrical measurement;

whereby, in a positive ambient concentration of said gas, said electrical measurement means detects changes in said electrical characteristic.

88. (Previously Presented) A two-electrode electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere at room temperature comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material;

wherein the electronic and ionic conducting materials of said sensing and counter electrodes are proton-electron mixed conductive materials having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials;

a first protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes, and having a thickness in the range of approximately 0.1 mm to 1 mm, the sensing electrode and the counter electrode being the only two electrodes in contact with the first protonic conductive electrolyte membrane;

the sensing electrode reacting with the gas at room temperature to produce a change in an electrical characteristic between the sensing electrode and the counter electrode in the absence of an applied voltage to the sensing electrode;

said sensing and counter electrodes each having a diameter in the range of approximately 1 mm to 15 mm, and being electrically connected to said electrical measurement means; and

means for electrical measurement;

whereby, in a positive ambient concentration of said gas at room temperature, said electrical measurement means detects changes in said electrical characteristic.

89. (Previously Presented) An electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere at room temperature, comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material; and

wherein the electronic and ionic conducting materials of said sensing and counter electrodes are proton-electron mixed conductive materials having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials;

a first protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes, and having a thickness in the range of approximately 0.1 mm to 1 mm, the sensing electrode and the counter electrode being on opposite sides of the first protonic conductive electrolyte membrane;

the sensing electrode reacting with the gas at room temperature to produce a change in an electrical characteristic between the sensing electrode and the counter electrode;

said sensing and counter electrodes each having a diameter in the range of approximately 1 mm to 15 mm, and being electrically connected to said electrical measurement means; and

means for electrical measurement;

whereby, in a positive ambient concentration of said gas at room temperature, said electrical measurement means detects changes in said electrical characteristic.

90. (Previously Presented) The electrochemical gas sensor of claim 89 in which the sensing electrode and the counter electrode are the only two electrodes in contact with the first protonic conductive electrolyte membrane.

91. (Previously Presented) The electrochemical gas sensor of claim 89 in which the sensing electrode is capable of reacting with the gas at room temperature in the absence of an applied voltage to the sensing electrode.

92. (Previously Presented) A non-biased electrochemical gas sensor for quantitative measurement of a gas in an ambient atmosphere at room temperature comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material;

wherein the electronic and ionic conducting materials of said sensing and counter electrodes are proton-electron mixed conductive materials having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials;

a first protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes, and having a thickness in the range of approximately 0.1 mm to 1 mm;

the sensing electrode reacting with the gas at room temperature to produce a change in an electrical characteristic between the sensing electrode and the counter electrode;

said sensing and counter electrodes each having a diameter in the range of approximately 1 mm to 15 mm, and being electrically connected to said electrical measurement means; and

means for electrical measurement;

whereby, in a positive ambient concentration of said gas at room temperature, said electrical measurement means detects changes in said electrical characteristic in the absence of any biasing voltage.

93. (Previously Presented) The non-biased electrochemical gas sensor of claim 92 in which the sensing electrode and the counter electrode are the only two electrodes in contact with the first protonic conductive electrolyte membrane.

94. (Previously Presented) The non-biased electrochemical gas sensor of claim 93 in which the sensing electrode is capable of reacting with carbon monoxide at room temperature to produce a change in electrical characteristic between the sensing electrode and the counter electrode in the absence of an applied voltage to the sensing electrode.

95. (Previously Presented) An electrochemical gas sensor for quantitative measurement of carbon monoxide gas in an ambient atmosphere comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material;

wherein the electronic and ionic conducting materials of said sensing and counter electrodes are proton-electron mixed conductive materials having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials;

a first protonic conductive electrolyte membrane in between and in contact with the sensing and counter electrodes, and having a thickness in the range of approximately 0.1 mm to 1 mm;

the sensing electrode reacting with the carbon monoxide to produce a change in an electrical characteristic between the sensing electrode and the counter electrode;

means for electrical measurement;

said sensing and counter electrodes each having a diameter in the range of approximately 1 mm to 15 mm, and being electrically connected to said electrical measurement means; and

whereby, in a positive ambient concentration of said carbon monoxide gas, said electrical measurement means detects changes in said electrical characteristic.

96. (Previously Presented) The electrochemical gas sensor of claim 95 further comprising a cap in communication with the sensing electrode.

97. (Previously Presented) A two-electrode electrochemical gas sensor for quantitative measurement of a carbon monoxide gas in an ambient atmosphere at room temperature comprising:

a porous mixed ionic-electronic conductive sensing electrode having both an electronic conducting material and an ionic conducting material, the sensing electrode

includes platinum, carbon and a copolymer having a tetrafluorethylene backbone with a side chain of perfluorinated monomers containing a sulfonic acid group;

a porous mixed ionic-electronic conductive counter electrode having both an electronic conducting material and an ionic conducting material, the counter electrode includes platinum, carbon and a copolymer having a tetrafluorethylene backbone with a side chain of perfluorinated monomers containing a sulfonic acid group;

wherein the electronic and ionic conducting materials of said sensing and counter electrodes are proton-electron mixed conductive materials having 10-50 wt% of a proton conductor material and 50-90 wt% of a first and a second electrical conductor materials;

a first protonic conductive solid electrolyte membrane in between and in contact with the sensing and counter electrodes, and having a thickness in the range of approximately 0.1 mm to 1 mm, the protonic conductive solid electrolyte membrane being substantially comprised of a solid, perfluorinated, ion-exchange polymer and being approximately 0.17 mm thick;

the sensing electrode reacting with the carbon monoxide gas to produce a change in an electrical characteristic between the sensing electrode and the counter electrode, the sensing electrode and the counter electrode being the only two electrodes in contact with the first protonic conductive electrolyte membrane and the sensing electrode and the counter electrode being on opposite sides of the first protonic conductive electrolyte membrane;

means for electrical measurement electrically connected to said sensing and counter electrodes;

said sensing and counter electrodes each having a diameter in the range of approximately 1 mm to 15 mm, and being electrically connected to said electrical measurement means, the sensing electrode being 15 mm in diameter and the counter electrode being approximately 15 mm in diameter;

whereby said electrical measurement means detects changes in said electrical characteristic in a positive ambient atmosphere concentration of said gas at room temperature.

98. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein said sensing and counter electrodes comprise carbon.

99. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein said sensing and counter electrodes comprise noble metals.

100. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein said sensing and counter electrodes comprise conductive metal oxides.

101. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the protonic conductive electrolyte membrane is substantially comprised of a solid, perfluorinated, ion-exchange polymer.

102. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the protonic conductive electrolyte membrane is a metal oxide protonic conductor electrolyte membrane.

103. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the electrochemical gas sensor is adapted to detect CO.

104. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the electrochemical gas sensor is adapted to detect NO_x.

105. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the electrochemical gas sensor is adapted to detect hydrogen.

106. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the electrochemical gas sensor is adapted to detect H_2S.

107. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the electrochemical gas sensor is adapted to detect H_2O vapor.

108. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the sensing and counter electrodes have a diameter of about 10 mm, and the protonic conductive electrolyte membrane has a thickness of about 0.17 mm.

109. (Cancelled)

110. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the proton conductor material for both the sensing and counter electrodes is a copolymer having a tetrafluorethylene backbone with a side chain of perfluorinated monomers containing at least one of a sulfonic acid group or a carboxylic acid group.

111. (Cancelled)

112. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein one of the first and second electrical conductor materials for the sensing electrode is 50-99 wt% of carbon black, and the other of the first and second electrical conductor materials for the sensing electrode is 1-50 wt% of platinum.

113. (Previously Presented) The electrochemical gas sensor as defined in claim 82, wherein the sensing and the counter electrodes each have a first side opposite a second side, and wherein the ionic and electronic conducting materials are continuous from the first side to the opposite second side within each of the sensing and counter electrodes.

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